

**Controls on highly siderophile element concentrations in martian basalt: sulfide saturation and under-saturation.**

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**Introduction:** Highly siderophile elements (HSE; Re, Au and the platinum group elements) in shergottites exhibit a wide range from very high, similar to the terrestrial mantle, to very low, similar to sulfide saturated mid ocean ridge basalt (e.g., [1]). This large range has been difficult to explain without good constraints on sulfide saturation or under-saturation [2]. A new model for prediction of sulfide saturation places new constraints on this problem [3].

**Shergottite data:** For primitive shergottites, pressure and temperature estimates are between 1.2-1.5 GPa, and 1350-1470 °C [4]. The range of oxygen fugacities is from FMQ-2 to IW, where the amount of Fe<sub>2</sub>O<sub>3</sub> is low and thus does not have a significant effect on the S saturation values. Finally, the bulk compositions of shergottites have been reported in many recent studies (e.g., [5]). All of this information will be used to test whether shergottites are sulfide saturated [3].

**Modeling values and results:** The database for HSE partition coefficients has been growing with many new data for silicates and oxides [6-8] to complement a large sulfide database [9-11]. Combining these data with simple batch melting models allows HSE contents of mantle melts to be estimated for sulfide-bearing vs. sulfide-free mantle. Combining such models with fractional crystallization modeling (e.g., [12]) allows HSE contents of more evolved liquids to be modeled. Most primitive shergottites have high HSE contents (and low S contents) that can be explained by sulfide under-saturated melting of the mantle. An exception is Dhofar 019 which has high S contents and very low HSE contents suggesting sulfide saturation. Most evolved basaltic shergottites have lower S contents than saturation, and intermediate HSE contents that can be explained by olivine, pyroxene, and chromite fractionation. An exception is EET A79001 lithology B, which has very low HSE contents and S contents higher than sulfide saturation values – evidence for sulfide saturation during late fractional crystallization. These results show that shergottite HSE contents are controlled by silicates, oxides, and sulfides. In addition, the mantle producing the most primitive shergottites did not contain near chondritic relative ratios of the HSEs like the terrestrial mantle, and did not experience a late chondritic veneer.

**References:** [1] Walker et al. (2009) LPSC XL, #1263; [2] Jones, J.H. et al. (2003) Chem. Geol. 196, 21-41; [3] Righter, K. et al. (2009) LPSC XL, #1428; [4] Filiberto, J. et al. (2008) MaPS 43, 1137-1146.; [5] Anand, M. et al. (2008) LPSC XXXIX, #2173; [6] Brenan, J.M. et al. (2003) Earth Planet. Sci. Lett. 212, 135-150; [7] Righter, K. et al. (2004) Geochim. Cosmochim. Acta 68, 867-880; [8] Mallmann, G. and O'Neill, H.St.C. (2007) Geochim. Cosmochim. Acta 71, 2837-2857; [9] Fleet, M. et al. (1996) Geochim. Cosmochim. Acta 60, 2397-2412; [10] Stone, W. et al. (1990) Geochim. Cosmochim. Acta 54: 2341-2344; [11] Crocket, J. et al. (1997) Geochim. Cosmochim. Acta 61, 4139-4149; [12] Symes, S. et al. (2008) Geochim. Cosmochim. Acta 72, 1696-1710.